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TROUBLED AIR

Public Health Service
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TROUBLED AIR

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U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
Public Health Service

30

TROUBLED AIR.....

CHART BOOK

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U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Division of Air Pollution
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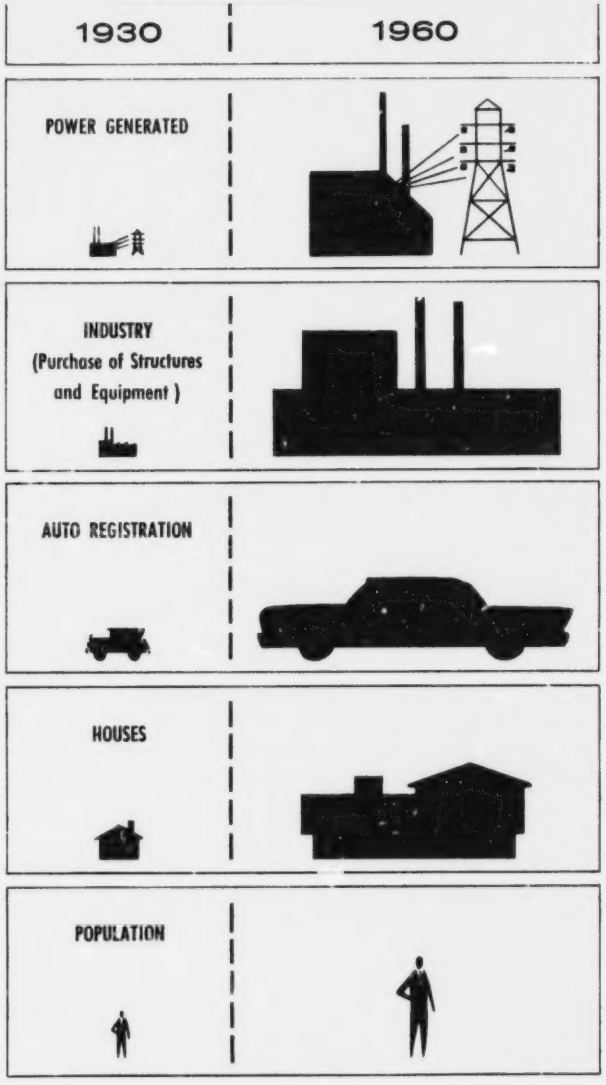
INTRODUCTION

Life, as we know it, depends upon the vast ocean of air which surrounds our planet. This transparent cocoon tempers our climate so we neither freeze in the dark of space nor fry under the sun's fierce heat. Its restless currents and convections bring moisture to water the land. But most important in this gaseous envelope is its oxygen, a little more than 20 percent of the gas volume of the atmosphere, necessary to almost all life processes.

For aeons, this atmosphere of ours contained little more than oxygen, nitrogen (about 78 percent), carbon dioxide, water vapor and traces of other gases. It was relatively pure. Its contaminants were fog, salt spray from the sea, pollen, dust, smoke from forest fires and from those that warmed men, dusts and gases spewed up by volcanoes and little else.

But in the relatively short period since the start of the industrial revolution, man has displayed an amazing capacity to drastically alter his natural environment. Today his mills and factories, chemical plants, transportation, heating equipment, power generators, and refuse incinerators have added huge amounts of pollutants to the air, some of which are new and strange to the earth's environment. These are minute particles of dust, smoke or fume, droplets or vapors of liquid chemical compounds or gases, some stable, others rare and transitory.

This booklet explores, in text and graph, what has produced these air pollutants, their characteristics, the damage they do, and what is being done to curtail further defilement of our troubled air.



WHEN WE ASK:

Why is there air pollution? The answer is relatively simple. It is:

PEOPLE AND CIVILIZATION.

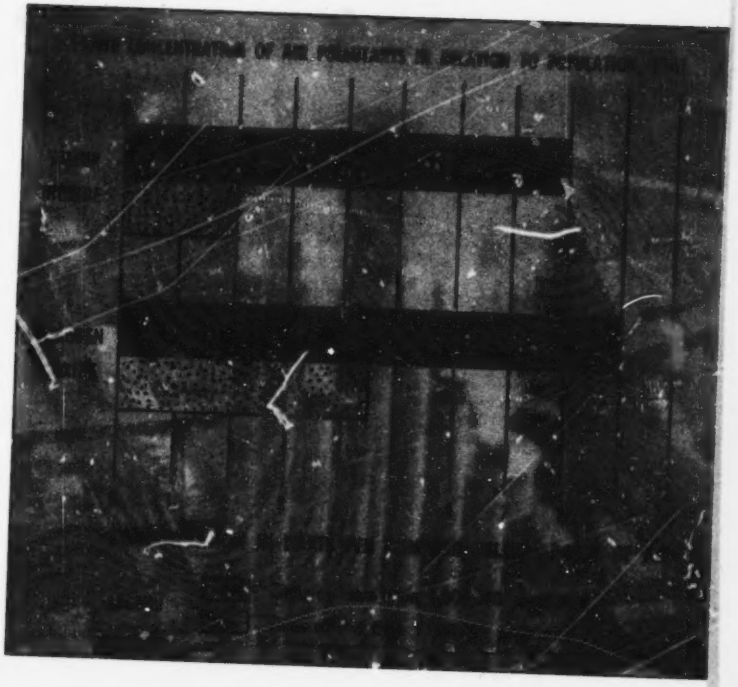
Since 1930, the population of the United States has increased about 50 percent. And the standard of living has gone up even faster. This has meant an increase of more than 100 percent in the number of homes, and 175 percent in the number of automobiles. More people living a more abundant life, too often means, as a by-product, more air pollution.

The means of creating an economy of abundance have shown an even more phenomenal growth. This is reflected in the nation's expenditure for industrial plants and equipment, up 500 percent, and power generated (in kilowatt hours), up 600 percent.

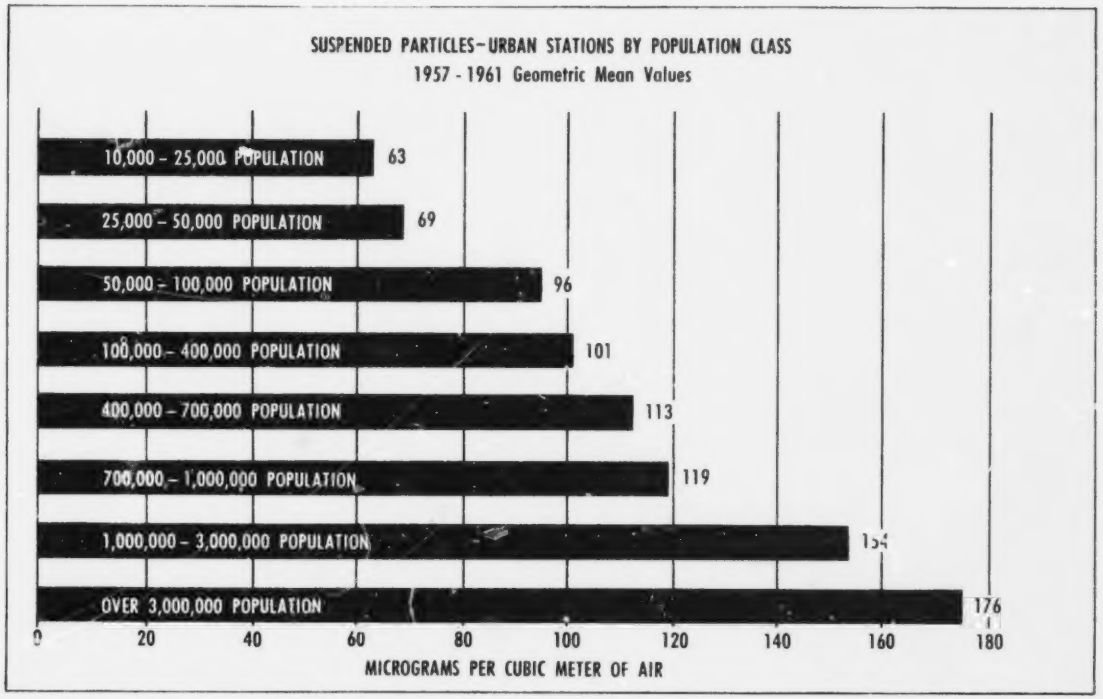
It is impossible to cite any one of these as THE cause of increased air pollution. They are all facets and reflections of increased activity. As a man stirs more dust when he runs than when he walks, so the accelerating pace of our civilization stirs more dust (and many other things) into our atmosphere.

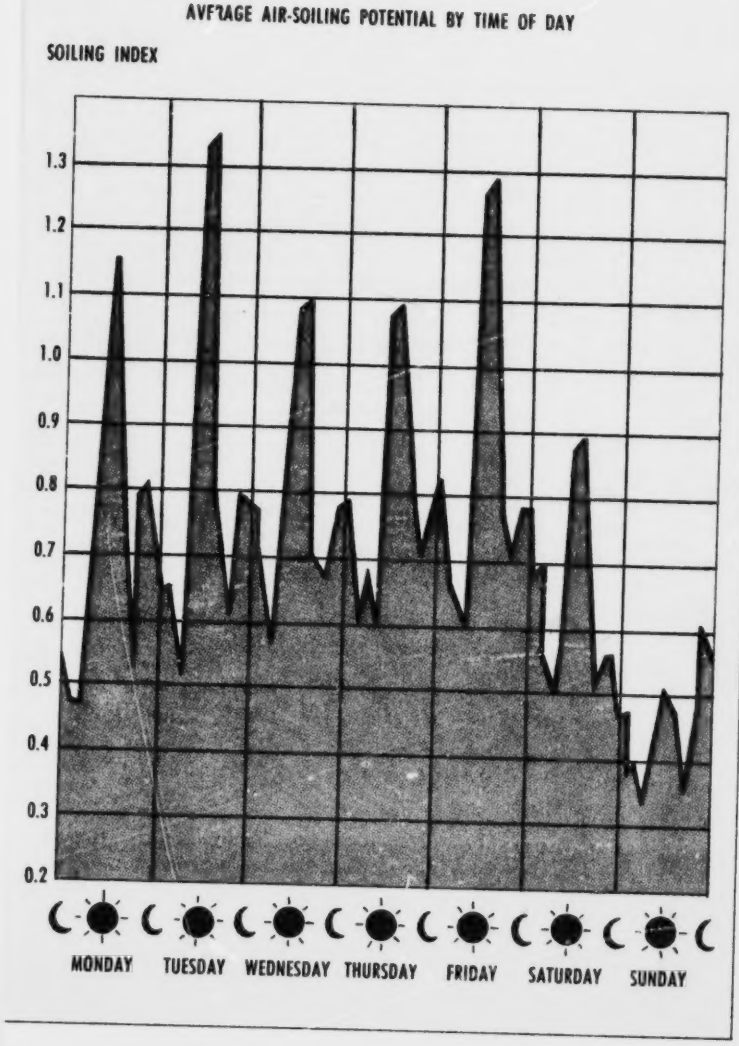
It is equally obvious that many men running can stir up a great deal of dust. It would follow, then, that there is a great deal more pollution in city air than in the open countryside. Even further, the kinds and amounts of air pollution are often geared directly to man's daily actions.

As population and human activity increase in a concentrated geographic area, polluting gases increase. The gases usually associated with fuel consumption and refuse burning are oxides of sulphur and nitrogen, and various carbon compounds, called "organics."



The amount of suspended dusts and other particles in the air shows the same relationship to population concentration. These frequently come from manufacturing processes of various sorts and from poorly-fired furnaces.

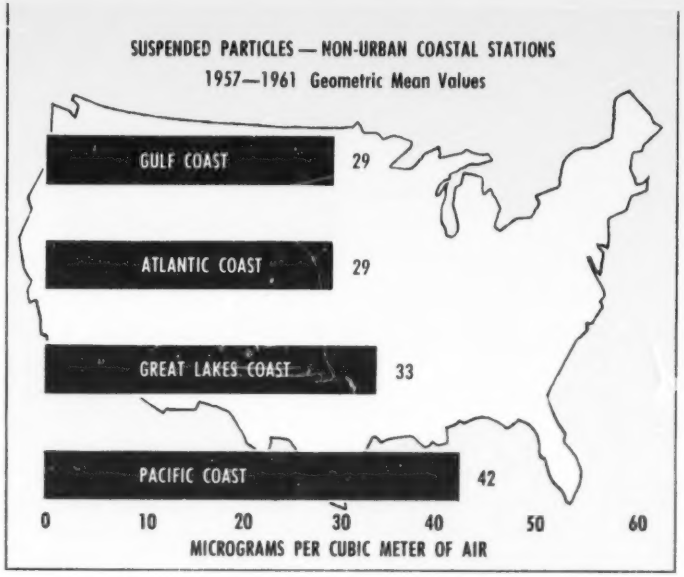




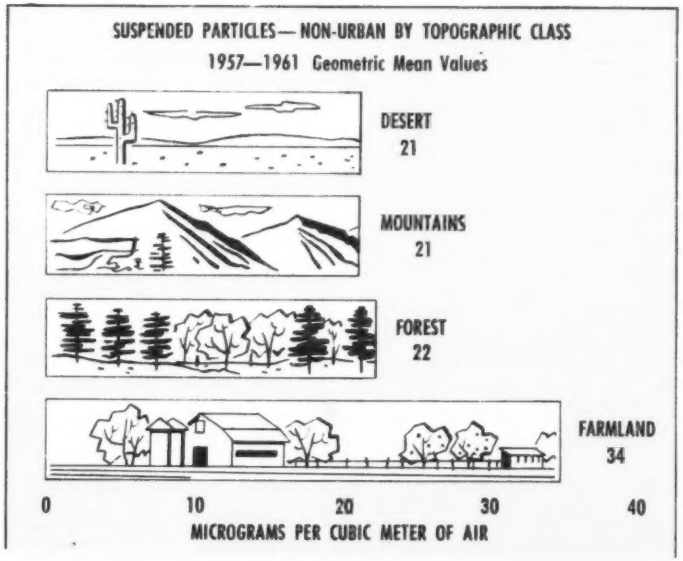
With some knowledge of a community's habits, an air pollution expert could almost set his watch by the amount and type of pollutants in the air.

There is smoke and sulphur dioxide in the morning as heating plants and factories start up. To these are added carbon compounds and nitrogen oxides from auto exhausts as people travel about during the day. During periods when factories are less active and fewer cars are on the streets, air pollution shows an expected drop.

It is not inconceivable that an expert could tell a great deal about the community, its characteristics and its population, just from an analysis of its pollution pattern.



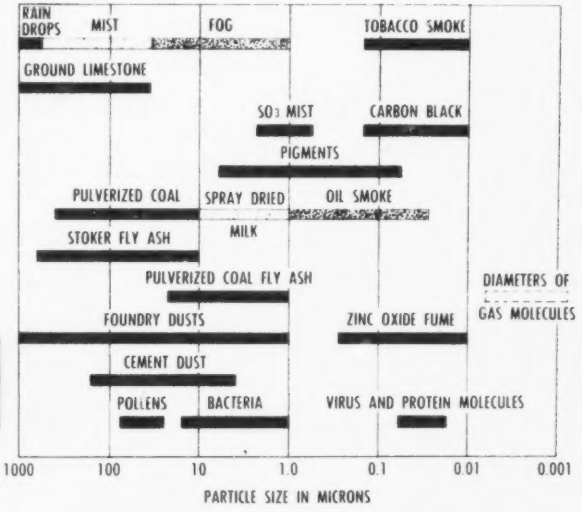
The amount of pollution in the air, as indicated by the floating dust particles, is related to both geography and topography. The map shows the air's dust content at selected coastal points away from the major cities in each area.



The air of deserts, mountains, forests, and the nation's broad farmlands, is clean compared with the air in urban areas.

WHAT IS IN THE AIR?

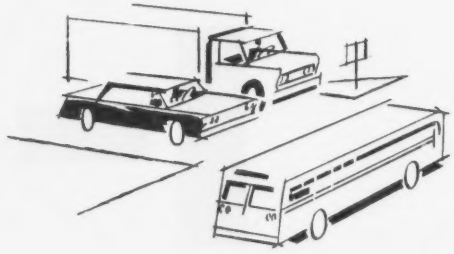
PARTICLE-SIZE RANGES FOR AEROSOLS, DUSTS, AND FUMES



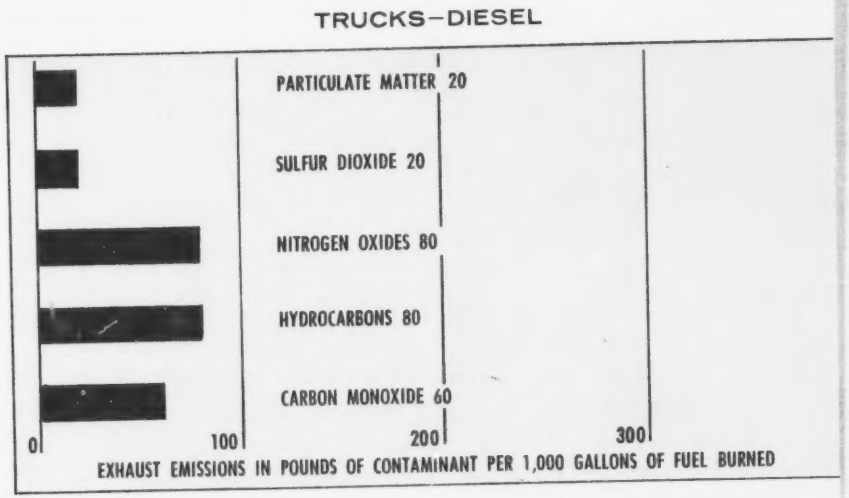
The materials which constitute what we call "pollution" are tiny and varied. They range from the molecules of gases and viruses which float endlessly in the air currents, to dusts and droplets, settling out rapidly within a few miles of their origin.

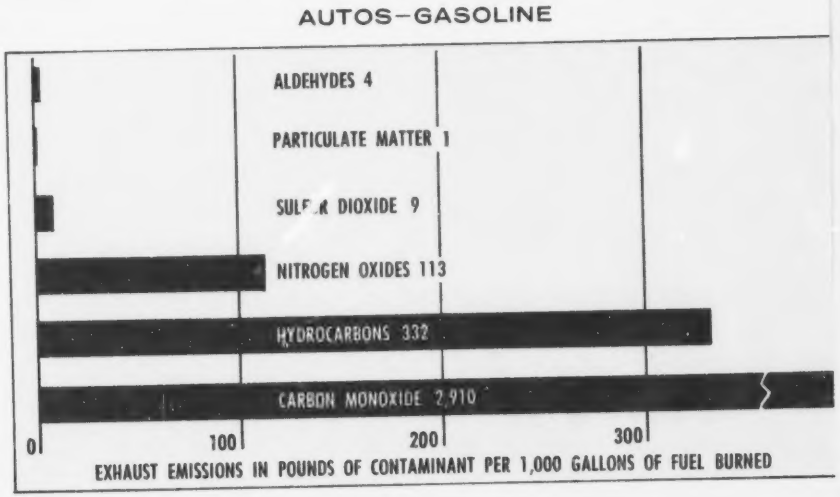
They are measured in microns. A micron is a millionth of a meter. The materials that pollute the air range in size from smaller than a hundredth of a micron to more than 100 microns in diameter. This chart shows the comparative size of some of the more familiar pollutants.

In an American metropolitan area of 1,000-000 people, nearly 120,000 automobiles are driven to town in the morning and out again in the evening each week-day. Another 40,-000 are moving continually during the day on the streets of the core city. Each day they use some 200,000 gallons of gasoline, pouring burned and unburned waste products into the air.



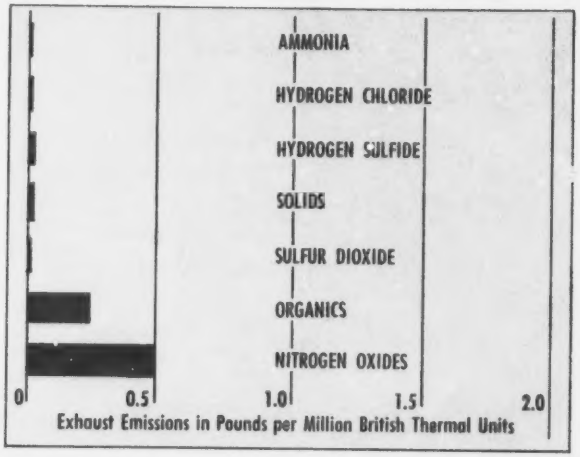
The graphs show the variety and comparative quantity of pollutants from our major means of locomotion.



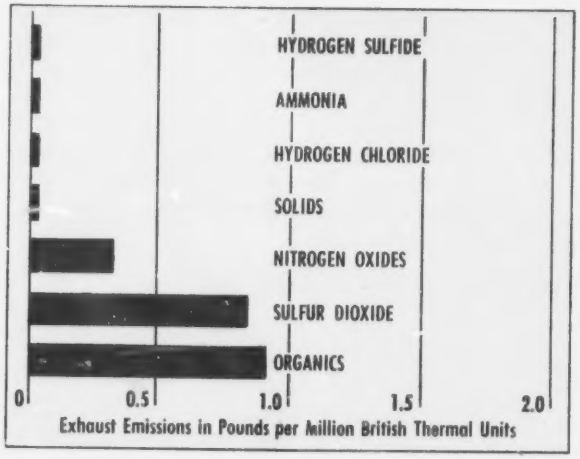


The fuels we use—coal, natural gas, and oil—whether employed to provide transportation, heat, industrial energy, or to generate electric power, also give forth in varying amounts a variety of air pollutants, the most significant of which are nitrogen and sulfur oxides, organics, and solid particles.

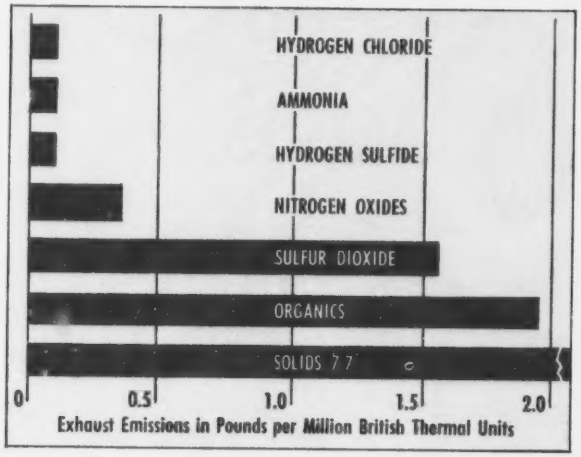
GAS

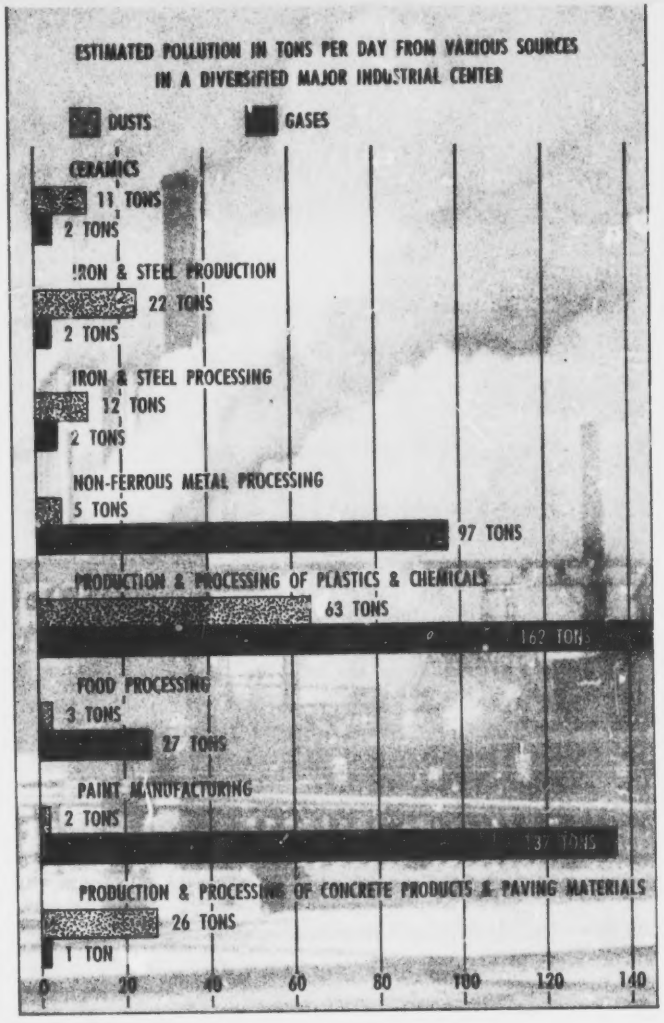


OIL



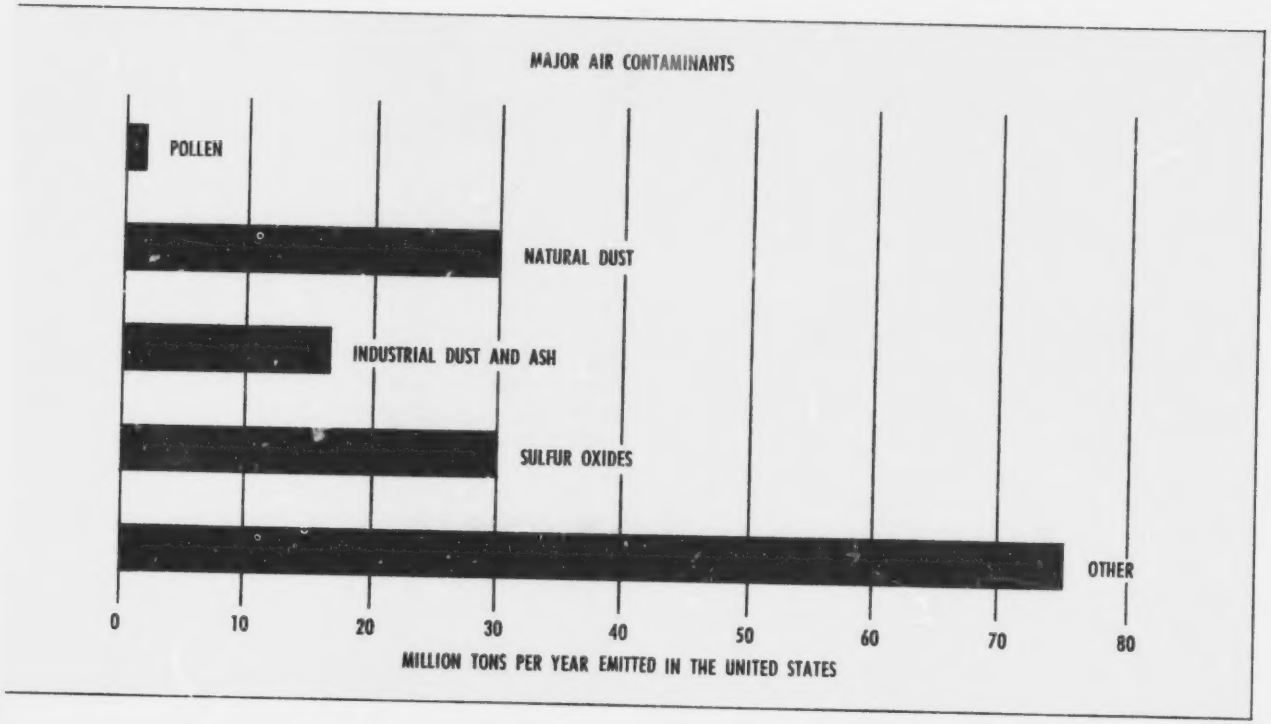
COAL





Industry, processing tons of raw materials for our needs and comforts, releases vast quantities and types of pollutants. These may be dusts, gases, fumes, or vapors. The pollution output of a typical American industrial center is shown in the chart. These are exclusive of pollution coming from other sources such as motor vehicles, power plants, and home heating equipment.

WHEN IT IS ALL SUMMED UP,
HERE ARE THE MAJOR AIR CONTAMINANTS IN OUR ATMOSPHERE
IN ANY TYPICAL 12-MONTH PERIOD.

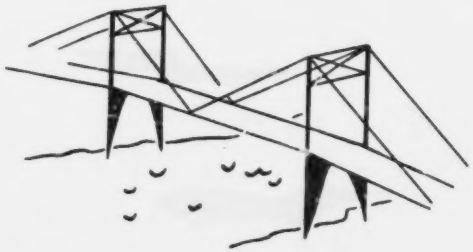


WHAT DOES IT DO?

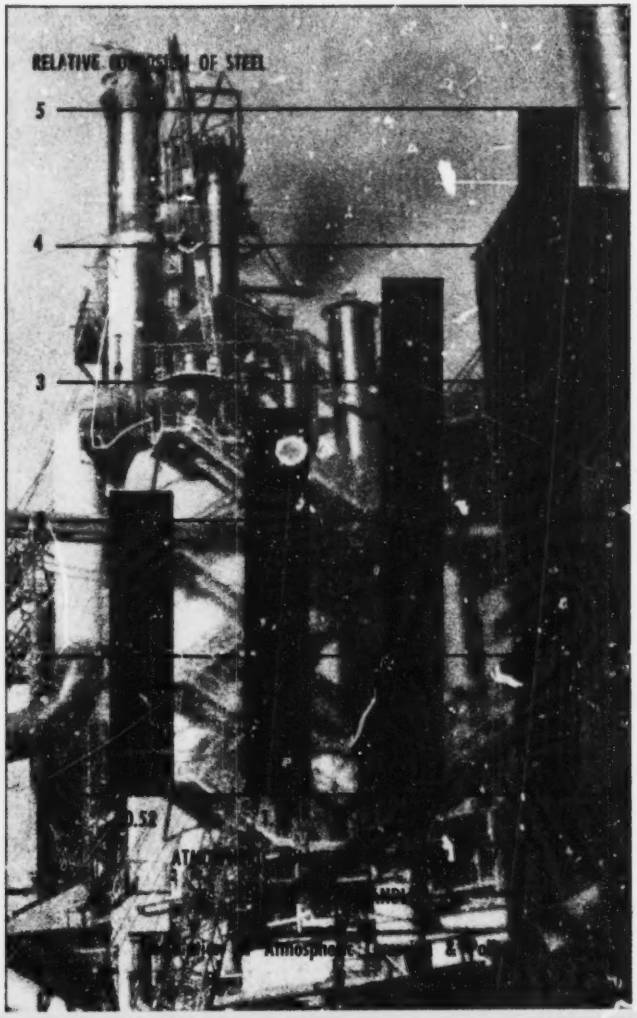
If pollution in the air were just a nuisance, soiling buildings or clothes hung out to dry, reducing visibility and delaying aircraft schedules, it might be accepted as a necessary annoyance. But as study follows study, more and more is learned about the temporary and permanent damage that polluted air does to materials, plants, and human health.

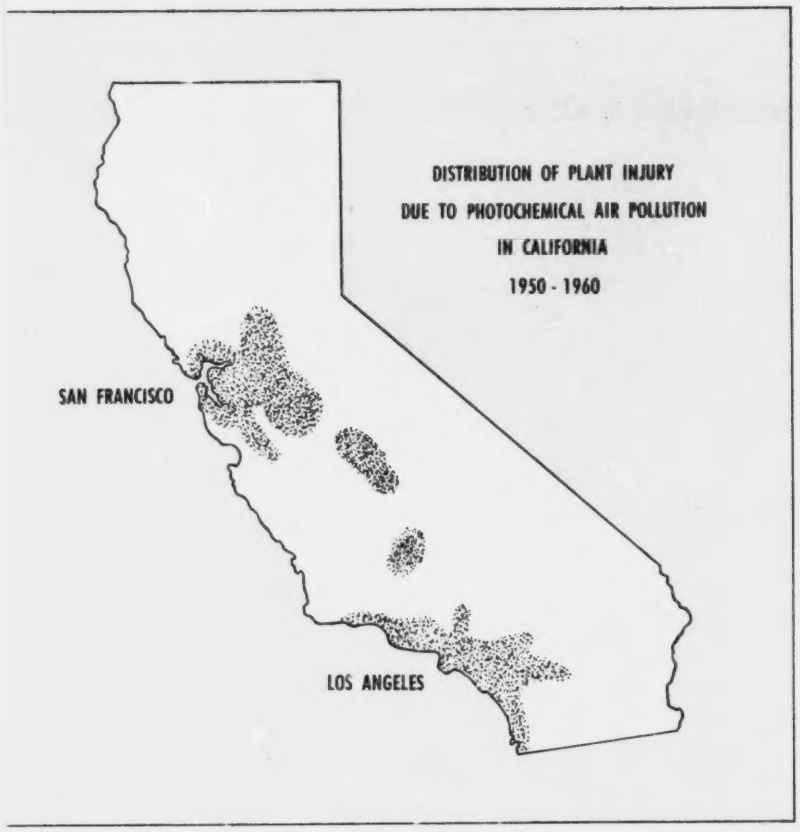
Pollutants that are discharged by the ton directly into community air are only a part of the problem. Some pollutants that are unstable to begin with, particularly those resulting from imperfect combustion, go through strange chemical changes under the influence of strong sunlight. While their existence is brief and their quantity small, they possess a dangerous potential for irritation and damage of living tissue.

Chameleon-like, they are as variable as the weather which helps to create them. A lot is known about some of these substances, little or nothing about others. But we do know that many of them are harmful.



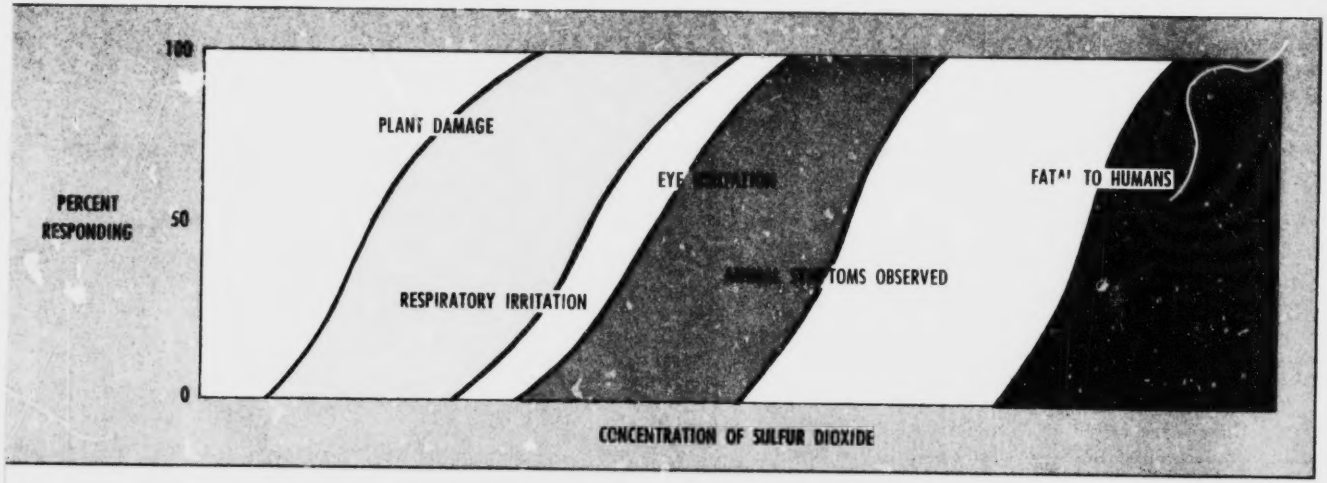
Most people are familar with the ordinary "weathering" of steel, whether it be auto bodies, porch furniture or bridge girders. Fewer people realize that the rate of corrosion is accelerated by some common pollutants in direct relation to the amount of them in the air. In this case, it is sulfur dioxide, a common by-product of many manufacturing and combustion activities.



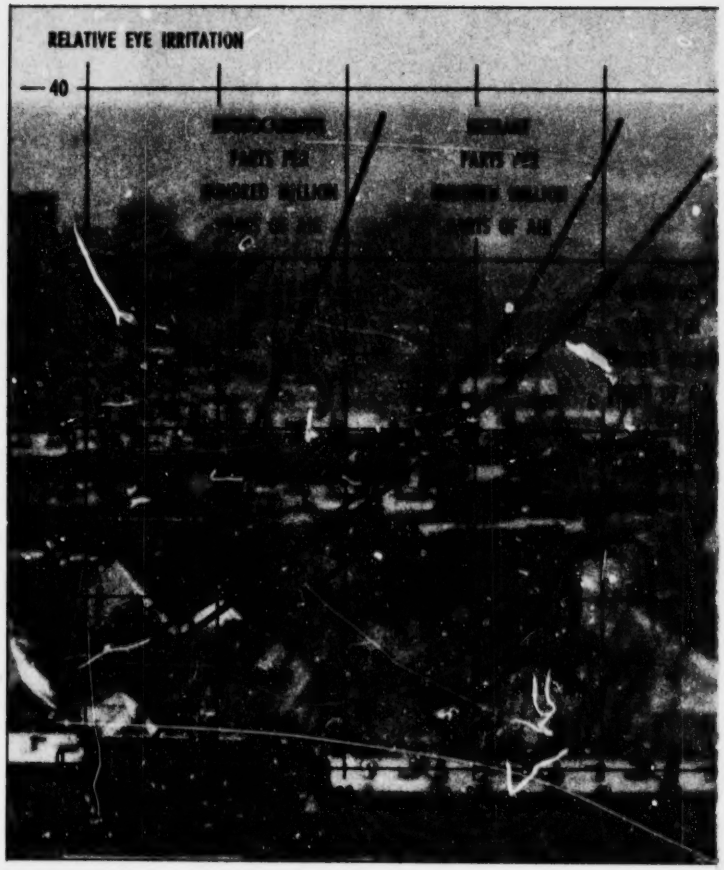


Garden crops suffer, too, from air pollution. Crop losses in any given location may run into millions of dollars. For example, a ten-year study of some of California's most productive agricultural areas shows the correlation between population centers, air pollution, and crop damage.

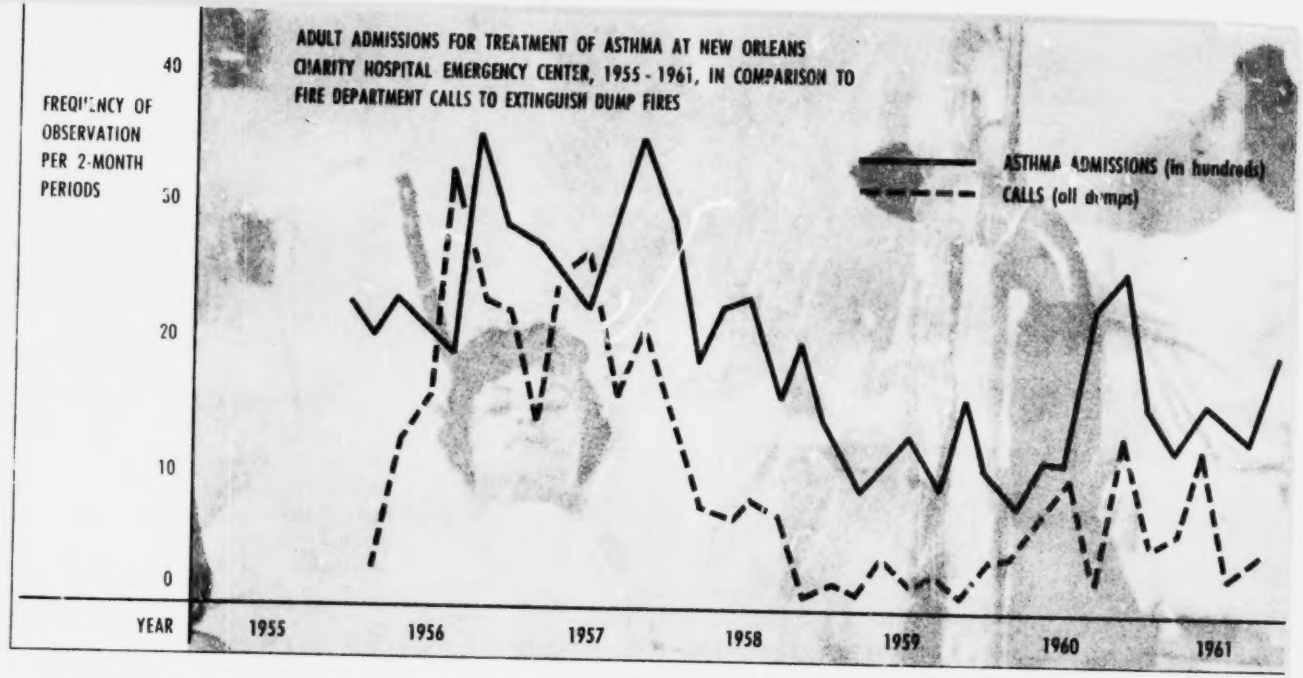
Not all tissue reacts at the same rate and in the same way to air pollution. There are variations, also, within any given animal or plant group. But eventually all suffer and die as the concentration mounts. The damage caused by a given pollutant, for example, sulfur dioxide, can be plotted, both for the type of tissue and the species, whether plant, animal, or human. The curves show an interesting and disturbing parallel. Plants seem to succumb first to the smallest amounts. Man shows eye irritation and respiratory effects. Then symptoms are observed in test animals as the concentration rises. Finally, both people and animals may suffer irreversible damage—or death.



Eye irritation, a common measure of pollution effect, varies also with the kind of pollutant. The common gaseous pollutants from the burning of fuel and from industry—hydrocarbons, oxidants, and aldehydes—have been shown to affect more people more seriously as concentration increases. But they don't all cause the same level of eye irritation at the same rate.



Minute dust particles in the air have more obvious effects, not only eye irritation, but also soiling of buildings and clothing and reduction of visibility. Few "dust" episodes are as dramatic as the dust storms of the 1930's, but anyone who has traveled by plane is familiar with the dust pall that hovers over our major cities and industrial centers. As the concentration of dust increases, the level of eye irritation rises and visibility is diminished.

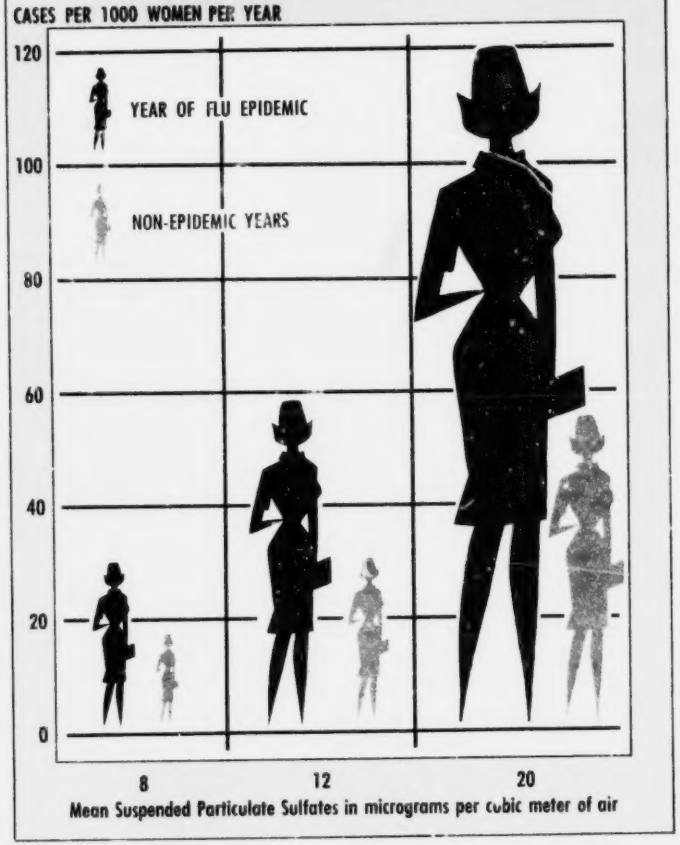


A prime source of dust and smoke is community refuse disposal. This is particularly true where refuse is burned in open dumps rather than in well-maintained and properly-fired incinerators. A six-year study in New Orleans showed that asthma attacks resulting in hospital admissions rose and fell almost consistently with the number of times the New Orleans Fire Department was called to extinguish dump fires.

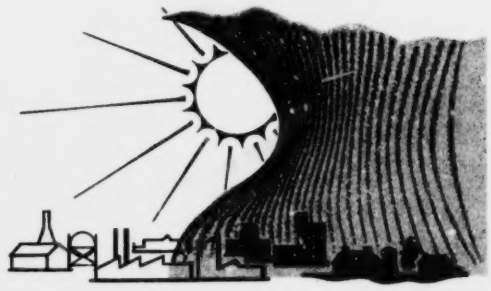
Factors such as wind and weather may have caused some variation, but the parallel is too close to be explained by chance alone. The pollutants, and possibly one in particular, from the burning dumps apparently have a consistently bad effect on people whose breathing is already made difficult by asthma.

RESPIRATORY DISEASE CASES PER 1000 WOMEN PER YEAR

Incidence of respiratory disease lasting more than seven days in women versus the mean suspended particulate sulfates in the city air. Year of flu epidemic corresponds to the insurance year of 1958. Non-epidemic years correspond to the insurance years of 1955 and 1957.

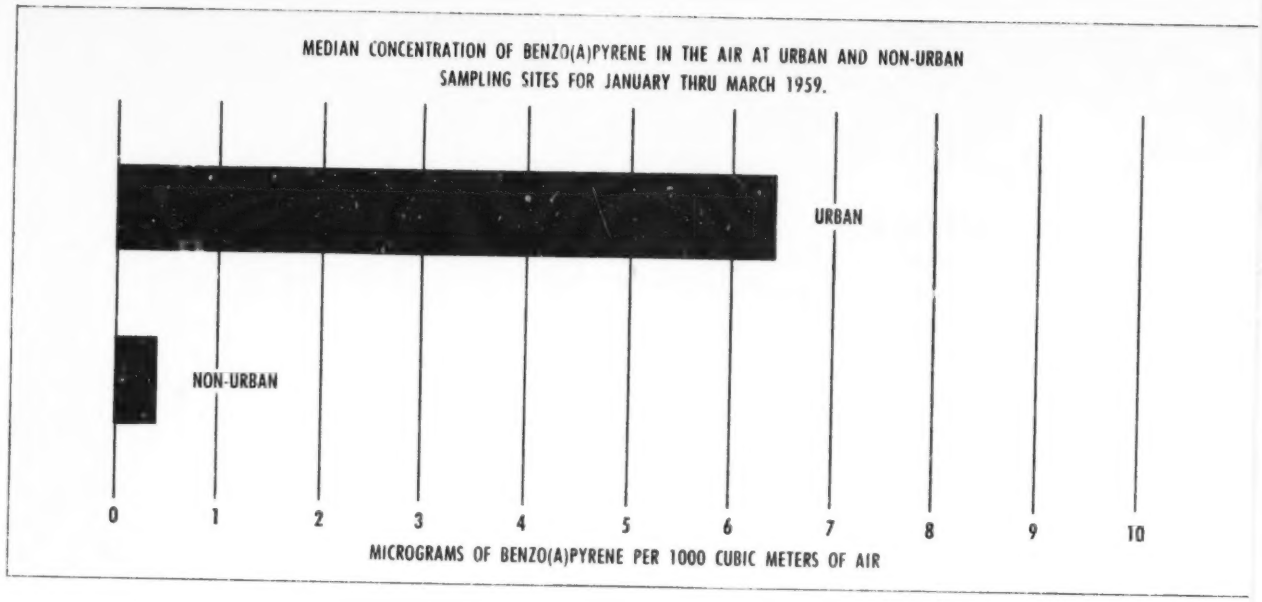


A study of sulfate in suspended dusts tends to bear out the thesis that respiratory difficulties are related to pollution levels. The higher the sulfate level in dusts, the more cases of respiratory disease are noted. When the respiratory systems of many people are affected as, for example, in an influenza epidemic, the amount of respiratory disease increases. Breathing systems, already made vulnerable by flu, may be more subject to other distress, particularly as the air pollution level rises.



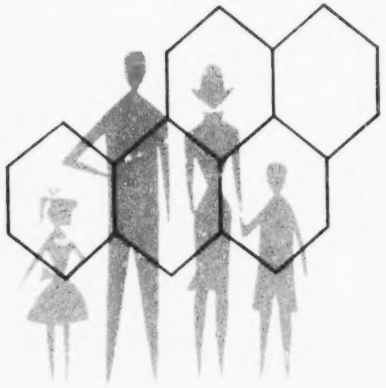
While there are serious economic consequences when air pollution affects plants and animals, of much more concern are the effects on people, their health, and their ability to do productive work. Paradoxically twentieth century man and his civilization have been the most serious offenders when it comes to discharging foul-smelling and frequently harmful substances into the air in increasing amounts.

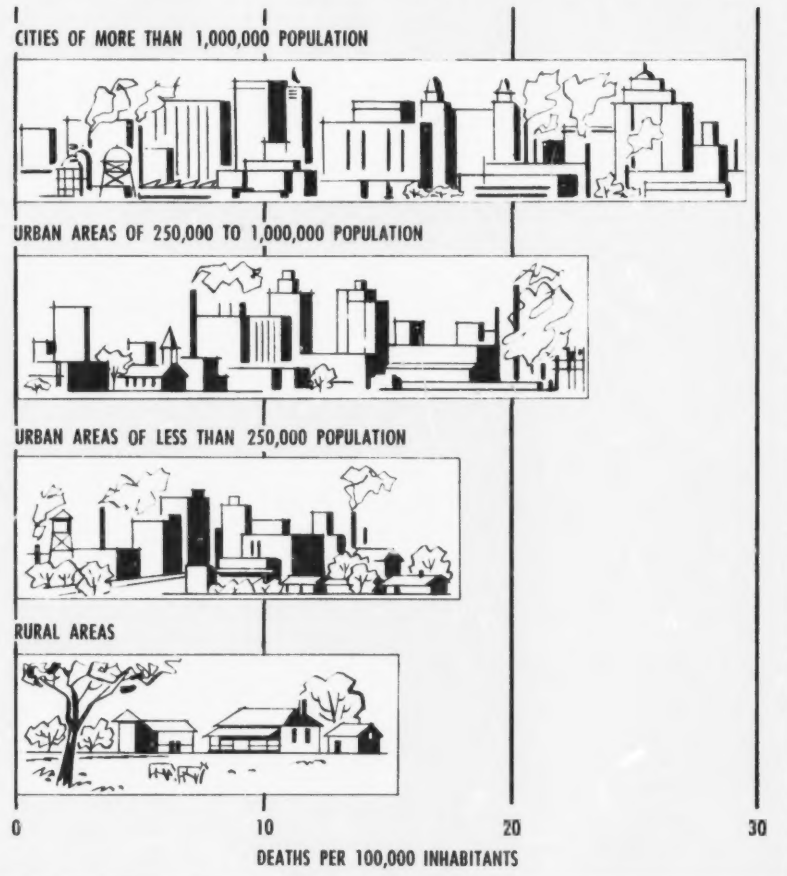
There have been critical "episodes" of air pollution in American and European cities causing illness and death. But of even more importance in the long run are the repeated insults to man, and particularly to his respiratory system, which contribute to chronic diseases, make people less effective at their jobs, absent more frequently from work and school, less healthy, and shorter lived.

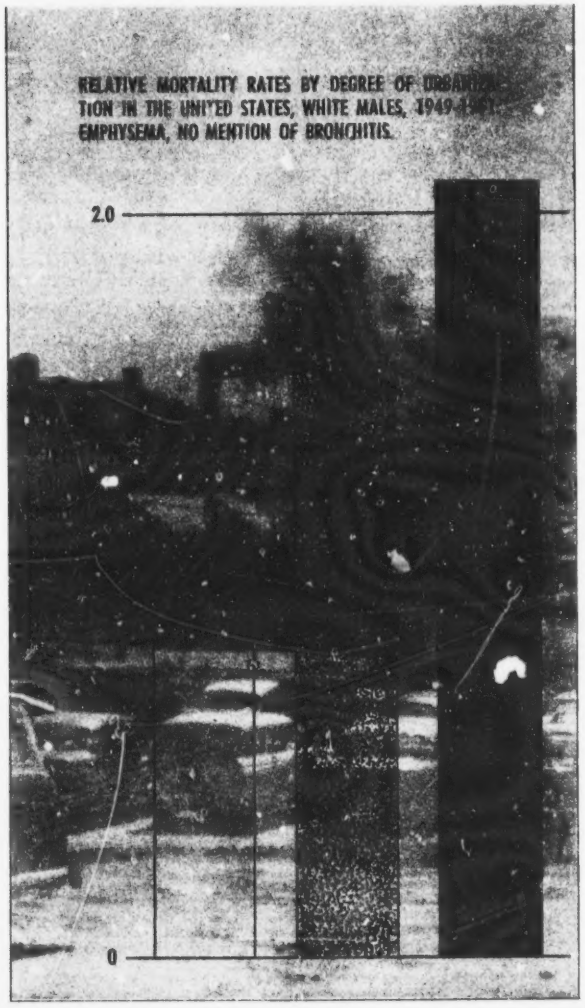


In recent years, much study of the effects of air pollution on people has centered around a substance called benzo(a)pyrene, an organic pollutant resulting from many sources, particularly those responsible for incomplete combustion of fuels or waste materials. It is almost exclusively caused by human activity and its concentration is many times higher in metropolitan areas than in rural areas. Benzo(a)pyrene has been found by many studies to be a potent carcinogen, or cancer-producing substance.

Insofar as respiratory diseases are concerned, city life is less healthful than rural life. In comparing death rates from all forms of cancer of the respiratory tract, there is almost a direct-line relationship between death rates and concentration of population. This parallels, to a great extent, the close relationship between population and concentration of pollutants.




MORTALITY RATES OF CANCER OF TRACHEA, BRONCHUS, AND LUNG FOR WHITE MALES.
CITIES OF MORE THAN 1,000,000 POPULATION
URBAN AREAS OF 250,000 TO 1,000,000 POPULATION
URBAN AREAS OF LESS THAN 250,000 POPULATION
RURAL AREAS
0
10
20
30
DEATHS PER 100,000 INHABITANTS



The same direct-line relationship holds, too, for other forms of respiratory diseases. One of these is emphysema, a loss of elasticity of the minute air sacs of the lung making the human respiratory system less efficient in absorbing oxygen and discharging carbon dioxide. Metropolitan areas show the highest death rate in which emphysema is a factor, rural areas the lowest.

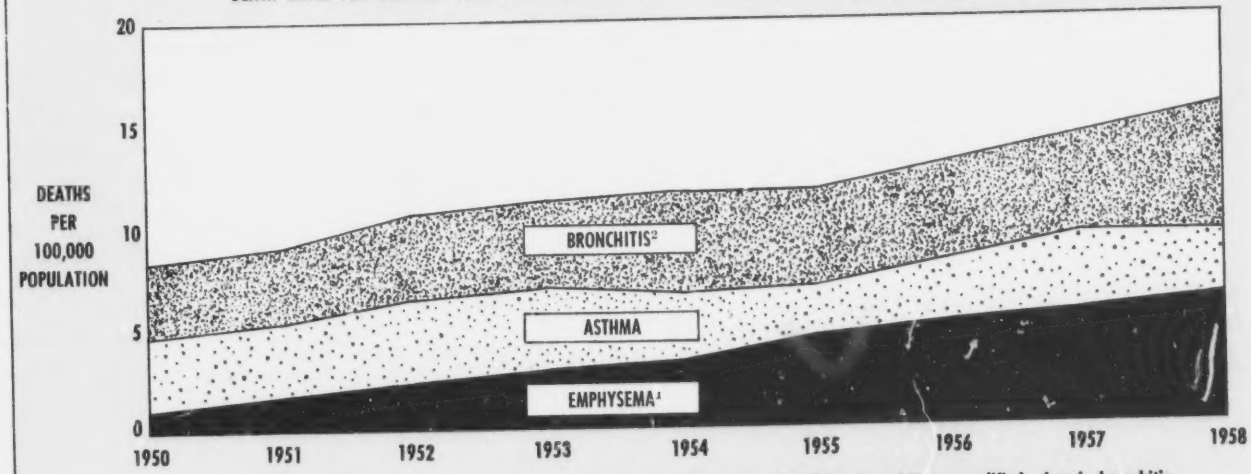
Metropolitan Area Counties containing Central City

Metropolitan Area Counties without Central City

All other Counties

Even when an entire state is studied, the pattern remains unchanged. An eight-year project begun in California in 1950 shows that, along with the increased population and increased productivity of the state, the death rate for lung-associated diseases rises, too.

DEATH RATES FOR SELECTED LUNG DISEASES, 1950-1958. EMPHYSEMA AND CARDIO-RESPIRATORY DISEASE. CALIFORNIA

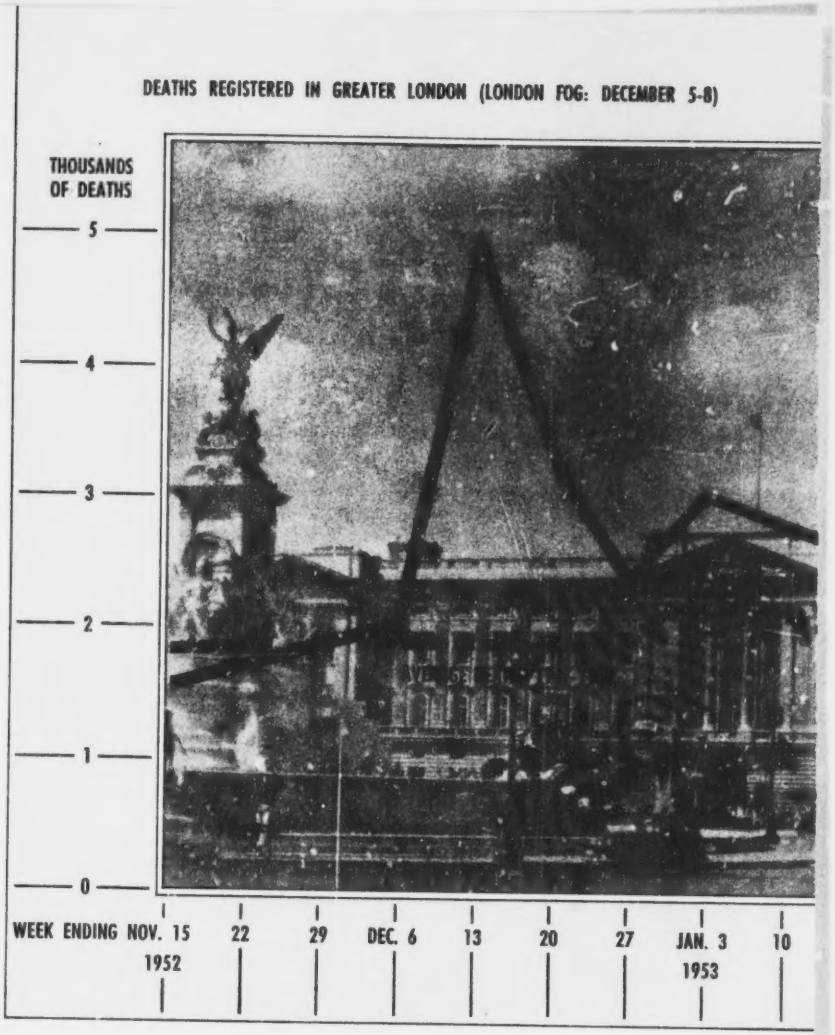


1 Emphysema with Bronchitis is included with emphysema.

2 Bronchitis includes acute bronchitis, bronchitis unqualified, chronic bronchitis, bronchiectasis, and other chronic interstitial pneumonia.

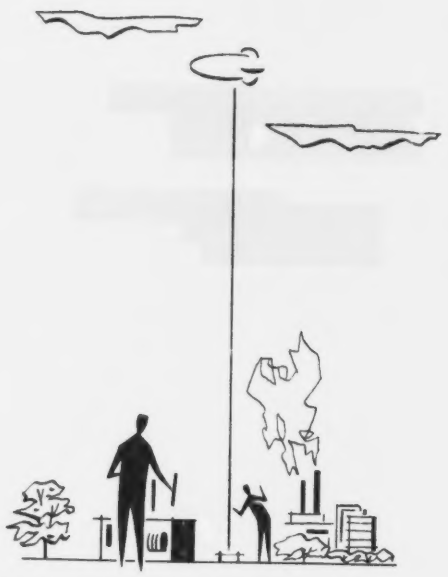
One of the physical effects of respiratory ailments is the strain they place on the heart. By rendering the oxygen-carbon dioxide exchange less efficient, they force the heart to work harder to satisfy the body's demand for oxygen. The minor "insults" of air pollution can be tolerated without too much difficulty, but a major pollution episode or the concentration of pollution by atmospheric conditions over a brief period may overwhelm the already weakened systems of many people.

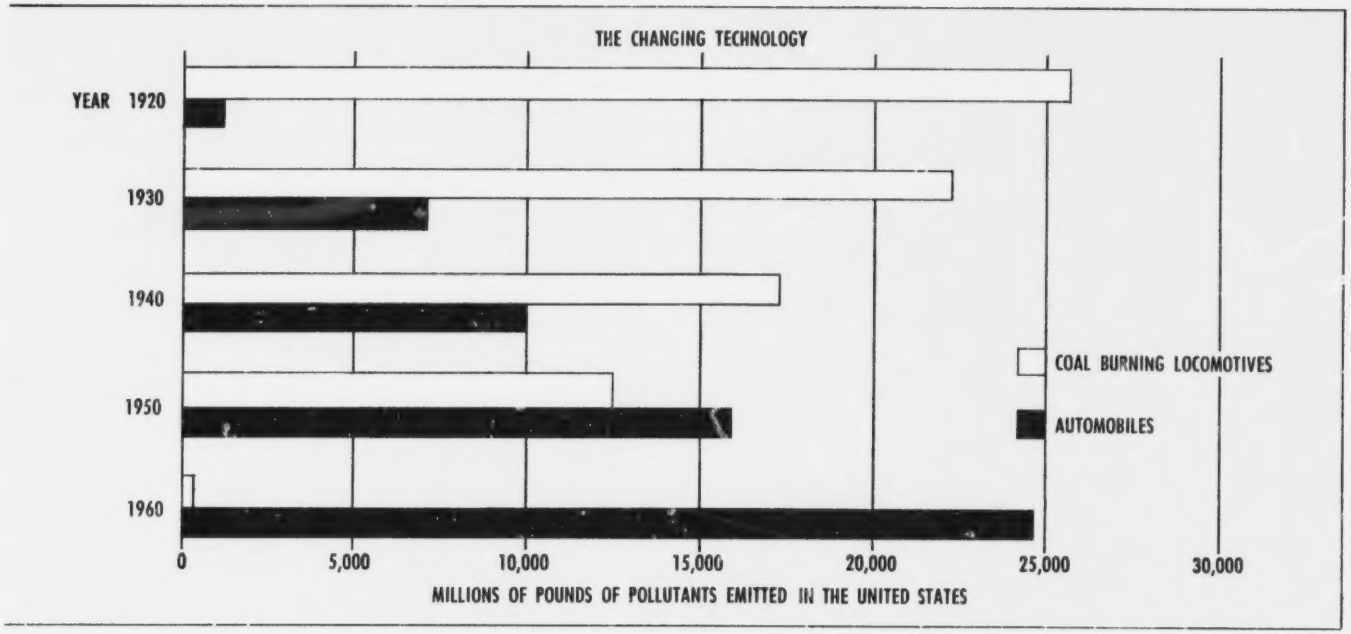
Possibly the most dramatic episode of this nature occurred in London in late November and December of 1952. In a metropolis with an average of about 2,000 deaths per week, the number rose to nearly 5,000 during an acute smog episode. The concentrated pollution literally engulfed and killed many whose hearts and lung systems already were weakened by disease.



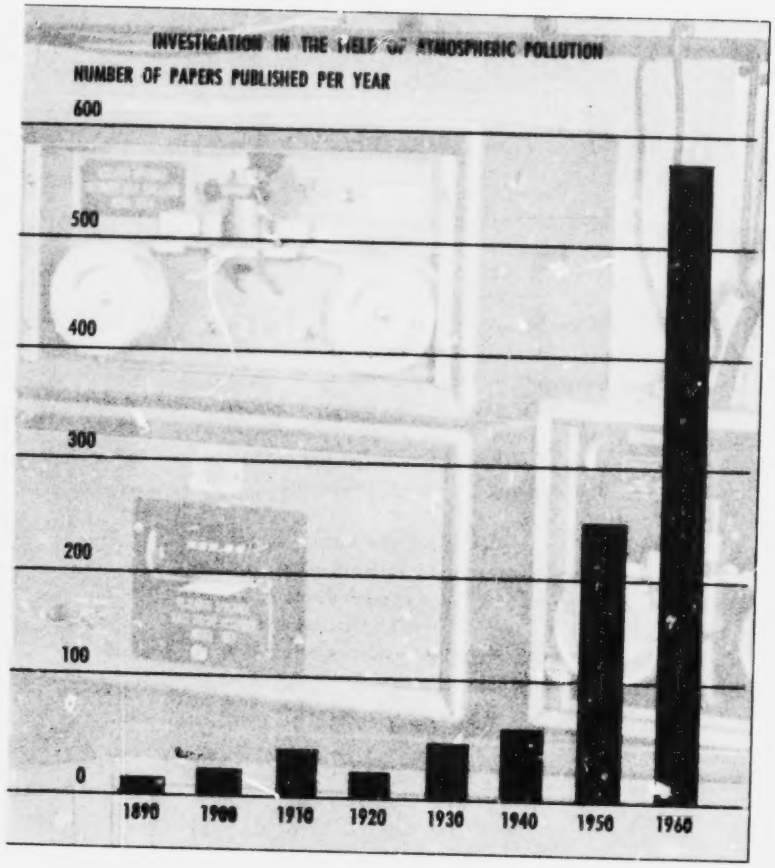
WHAT CAN WE DO ABOUT IT?

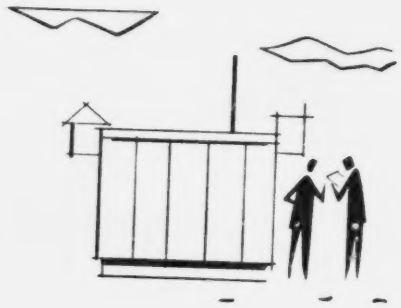
The task that confronts us is serious and challenging, but it can be accomplished. This Nation must stop, by every appropriate means, the destruction of our usable air resource. Although more research is needed to provide a better understanding of air pollution and its effects on human health and well-being . . . although engineers, scientists, and technicians will have to devise and perfect new methods of curbing the output of pollutants from many different sources . . . we need not wait for these achievements. The knowledge and skills are available now to bring about a major reduction in the problem of air pollution. The effort required will be great; but the return in improved living and working environments, better health, and fuller enjoyment of the product of our labors will far exceed the investment.





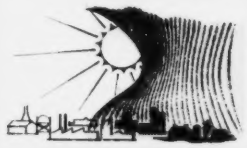
Technological change is reflected in the kinds of air pollution sources requiring attention. Here is an illustration of such change. In 1920, most goods were transported by coal-burning locomotives, which today have almost dissappeared.





Although there was concern over air pollution as long as seven centuries ago, interest in positive programs, other than the prohibition of black smoke from the burning of soft coal in the London slums as recent as 1890. But more than 50 additional years were to pass before a serious scientific effort to deal with the problem was launched. In the decade between 1940 and 1950, the number of research papers published in the field quadrupled. It doubled again by 1960.

In the last analysis, the key to solving the air pollution problem is cooperative action, cooperation among government at all levels, industry, and the people.



No one segment of American life can effectively stem the rising tide of air contamination that has accompanied the growth of modern, technological society. Its solution will demand not only the talents of physicians, scientists, and engineers, but of legislators, economists, sociologists, public administrators, and others in the many fields of knowledge concerned with man's relation to, and control of, his environment.

There is neither time nor good reason for the nation to put off making a concerted effort to meet the challenge of air pollution. The serious and potentially dangerous effects of air pollution on human health and welfare are known, as are the methods of controlling many of the major sources of air pollutants. A concerted effort *now* can meet the challenge of air pollution.

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